Zemo Partnership

Zero Emission Bus Certification ID: ZEB-YUTONG-TCE12-2022-----

Approved Test facility UTAC

Zero Emission Bus Certificate

Customer:	**Pelican Bus and Coach**			**DYNAMOMETER SETTINGS**		
Customer Address:	**Wakefield Europort, Alofts Lane, Wakefield**	*Telematics Capability*	Yes	Test Weight	15585	kg
Test Purpose:	**Zero Emission Bus Testing**	*Maximum Speed (km/h)*	80 km/h	F^0	66.05	N
Vehicle Manufacturer:	**Yutong**	*Seated Capacity*	50	F^1	-4.6295	N/kmh
Vehicle Model Name:	**TCe12**	*Passenger Capacity*	50	F^2	0.4	N/kmh ^{2}
Powertrain Technology	**Battery Electric**	*Declared Unladen Weight (kg)*	13885	F^3	-0.0027	N/kmh ^{3}
Powetrain Configuration	**Direct Drive**	*Gross Weight (kg)*	18500	*Equivalent test passengers*		25
Zero Emission Heating	**PTC Heaters**	*GVW Check*	**OK**	*Measured Unladen Weight (kg)*		13885

Battery Specification		**Charging and Refuelling Capability**		**Hydrogen Specification**	
Battery Manufacturer	**CATL**	**Plug Type**	**DC CCS 2**	**Fuel Cell Manufacturer**	**N/A**
Battery Chemistry	**LFP**	**Max Charge Capability (kW)**	**Up to 150kW**	**Fuel Cell Power Rating (kW)**	**N/A**
Battery Installed Capacity (kWh)	**281**	**Charger Compatibility**	**DC**	**Hydrogen Storage Capacity (kg)**	**N/A**
Battery Usable Capacity (kWh)	**247**	**Charge time from 20-80% SOC**	**1.5 - 4 hours**	**Hydrogen Storage Pressure (bar)**	**N/A**

Declared fuel, properties and source plus carbon conversion factors

Well-to-Tank Factor:	***Electricity***	**80.92**	**g CO2e / MJ**	*Fuel Provider*	**UK market standard**	*WTT evidence*	**DBEIS Conversion 2021**
Well-to-Tank Factor:	***Hydrogen***	**N/A**	**g CO2e / MJ**	*Capacity of Tanker (kg)*	**N/A**	*Fuel Type / Pathway*	**UK Grid Electricity**
Energy Density	***Hydrogen***	**120**	**MJ / kg**	*Transport Distance of Hydrogen (km)*	**N/A**	*Hydrogen Production Energy Source*	**UK Grid**

Emissions and Energy consumption results from approved test facility - Average 4 tests

Test Phase	HC (g/km)	CO (g/km)	NOx (g/km)	PM (g/km)	CO_2 (g/km)	CH_4 (g/km)*	N_2O (g/km)*	Total Energy Consumed (kWh)	Vehicle Energy Consumption (kWh/km)	Grid Electrical Energy Consumption (kWh/ 100km)
Outer Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.31	0.97	135.62
Inner Urban	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3.36	1.33	185.95
Rural	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5.12	0.69	96.47
LBC Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.67	1.07	149.60
UK BUS Average	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14.79	0.90	**125.83**

Zero Emissions (Z.E.) Range: Energy consumption and charging efficiency

Test Charger Used	**22 kW**	**Total measured energy consumed on vehicle (kWh)[1]**	**108.00**	**Max ZE Range at 100% SOC (km)**	**275**
Hydrogen Energy Over Test (kWh)	**N/A**	**Measured grid energy during charging (kWh)**	**151.00**	**Max ZE Range at 80% SOC (km)**	**220**
Hydrogen Delivered to Vehicle (kg)	**N/A**	**Grid-to-Wheel efficiency (%)[2]**	**72%**	**Test Distance Travelled (km)**	**121**

[1] Total measured energy includes energy used during the 23 minute warmup, this is needed for charge efficiency calculation.

[2] Grid to Wheel efficiency represents the total energy losses between the grid and the wheels of the bus.

Calculated total Well-to-Wheel GHG CO_2 equivalent emissions over test

Test Phase	Fuel Energy (MJ /km)	Fuel WTT*GHG Emissions (g CO_2e / km)	Electrical Energy (MJ / km)	Electricity WTT* GHG Emissions (g CO_2e / km)
Outer Urban	N/A	N/A	4.88	395.08
Inner Urban	N/A	N/A	6.69	541.71
Rural	N/A	N/A	3.47	281.04
LBC Average	N/A	N/A	5.39	435.81
UK BUS Average	N/A	N/A	4.53	366.57

Data Generated by (On behalf of Test facility): *Date:*

Data Approved by: *Date:*

Zero Emission Bus Certificate Summary

Test Vehicle			*Average Euro VI Diesel Equivalent*		
GHG Well-to-Wheel	**366.6**	**g CO2e / km**	**Average Diesel Equivalent**	**951**	**g CO2e / km**
WTW CO2 per passenger km (@ Max Pass Capacity)	**7.3**	**g CO2e/pass km**	**WTW CO2 per passenger km (@ Max Pass Capacity)**	**19.0**	**g CO2e/pass km**

Overall Zero Emission Bus Performance

WTW GHG saving	**584.4**	**g CO2e / km**	**Maximum Theoretical Zero Emission Range (km)**	**274.8**
% WTW GHG saving	**61%**	**g CO2e / km**	**Vehicle Energy Consumption (kWh/ km)**	**0.9**
Approved as Zero Emission Bus? (50% GHG saving or more)			***YES***	

** WTT : Well-to-Tank* *** TTW : Tank-to-Wheel* **** WTW : Well-to Wheel*

COMMENTS: Emission results marked in red are below detection levels.

LBC = London Bus Cycle - Inner & Outer Urban phases of UKBC only.

	Cell	Lower Saloon	Upper Saloon
Target Temperatures ±2 (°C) :	10	17	N/A
Average Temperatures across testing (°C)	9.58	16.72	N/A

Test Numbers: ML02019316 (13-Aug-20), ML02019317 (13-Aug-20), ML02019318 (13-Aug-20), ML02019319 (13-Aug-20).

Certificate approved by:
On behalf of Bus manufacturer

Certificate Approved by:
On behalf of DfT / Zemo Partnership

Dan Hayes 25.04.2022